

# LABS

## ACCOMPLISHMENTS

*Exceptional service in the national interest*

**SandiaLabNews**  
**March 2015**



**Sandia**  
**National**  
**Laboratories**





To all Sandians:

Welcome to the 2015 edition of the *Labs Accomplishments*, a compilation of some of the best work we have done at the Laboratories over the past year. As you look through this year's accomplishments, I'm sure you'll share the pride I feel in being part of an organization that serves the nation across such a wide swath of complex technical challenges.



PAUL HOMMERT

Impressive as this list of accomplishments is, it is by no means a comprehensive picture; it would take hundreds of pages just to summarize our work over the past year, and even then would be incomplete because it wouldn't address some of our most important accomplishments, sensitive work that cannot be shared in an open publication.

In our 2014-2018 Strategic Plan, our Laboratories Leadership Team noted, "Our unique mission responsibilities in the nuclear weapons program create a foundation from which we leverage capabilities, enabling us to solve complex national security problems." This collection of accomplishments vividly demonstrates that the ideals expressed in our mission statement are realized every day in our laboratories, our offices, and our test facilities across all of our sites.

On the wall of my office I have a small framed print of the words President John F. Kennedy spoke at Rice University in 1962: "We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard."

I think of those words often because they remind me of what we do here at Sandia — the nation asks us to do the hard things, to take on the daunting challenges we are uniquely qualified to address.

Our eight mission areas are amply represented here: We are making important progress in our core nuclear weapons mission and are instrumental in providing policy makers with technical assessments of existing and emerging nuclear threats. Our researchers are at the forefront of efforts to foster nonproliferation and reduce global nuclear dangers, and we are supporting our warfighting capabilities with innovative technologies. In the increasingly important arena of cyberspace, our experts are seen as leaders in developing the tools and technologies to defend and protect our nation's vital cyber infrastructure. In a world where technical challenges honor no national boundaries, our people are in the vanguard of addressing global chemical and biological dangers and securing a safe and sustainable energy future.

Finally, as you consider these accomplishments, I ask you to think about the people behind them. These are, by and large, team accomplishments, realized by a diverse workforce working with the best tools and resources the nation can provide.

It has been my greatest privilege during my tenure as Laboratories director to share these accomplishments with our customers in Washington and elsewhere, to say, "This is what it means to provide exceptional service in the national interest."

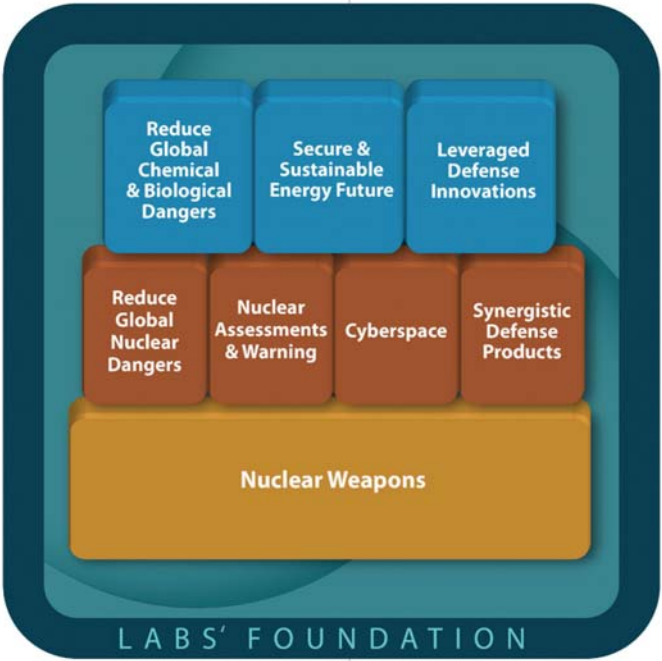
— Paul Hommert, Sandia President and Laboratories Director

Inside . . .

Nuclear weapons engineering . . . . .	3, 4	Military programs . . . . .	9
Nuclear weapon security . . . . .	5	Supply chain . . . . .	9
Remote sensing . . . . .	6	Pulsed power . . . . .	10
Product realization . . . . .	6	Engineering sciences . . . . .	10
Global security . . . . .	7	Microelectronics & microsystems . . .	11
Cybersecurity . . . . .	7	Homeland security . . . . .	11
ES&H & security . . . . .	7	Energy . . . . .	12, 13
Bioscience . . . . .	8	Robotics . . . . .	13
Computer & info sciences . . . . .	8	HR, communications, finance, & legal . . . . .	14
IT, networks, & facilities . . . . .	9	Governance, leadership, & management . . . . .	15
Partnerships & alliances . . . . .	9		

This year's *Labs Accomplishments* publication recognizes some of Sandia's best work during 2014, as submitted by center offices and selected by division offices. Most citations are followed by the numbers of the centers that contributed most directly to the effort described.

Laboratories Framework



Today, Sandia faces new challenges resulting from the totality of our work. Sandia is engaged in the significant demands of the nation's nuclear weapons modernization program while continuing to conduct an extraordinary range of activities in broader national security areas. More than ever, we must effectively manage the Laboratories' capabilities and mission commitments to strengthen the core mission work while simultaneously continuing to advance our other missions. We developed a new Laboratories framework to capture the entirety of our work while positioning the Laboratories to evolve and bring greater stability to our broad national security role. The new Laboratories framework, shown above, provides a basis for describing Sandia's mission and capability space and for prioritizing the work of the Laboratories. Three key characteristics — synergy with nuclear weapons capabilities, national security impact, and strategic value to the nation to ensure Sandia's enduring impact — were used to identify seven integrated missions, in addition to the nuclear weapons core mission. Together, all eight mission areas are supported by a robust foundation (see below) that enables Sandia's success as a sustainable 21st century, broad-spectrum national security laboratory. — From Sandia's 2014 - 2018 Strategic Plan

Labs foundation underpins mission areas



The Laboratories' foundation — the very base that gives our institution its energy, meaning, and uniqueness — is composed of our people, research, facilities and tools, and capabilities. In keeping with our vision to be the nation's premier science and engineering laboratory for national security and technology innovation, we recruit the best and the brightest, equip them with world-class facilities and tools, and build upon long-standing research by advancing the frontiers of science and engineering, giving rise to unique capabilities that differentiate Sandia's ability to deliver its mission.

You'll see two sets of acronyms following most of the accomplishments in this document. The first set, following the center numbers in parentheses, indicates which of Sandia's program management units (PMUs) the work most directly supported. The PMU acronyms are:

- NW: Nuclear Weapons • DSA: Defense Systems & Assessments • IHNS: International, Homeland, & Nuclear Security • EC: Energy & Climate • IMS: Integrated Mission Support
- \*\*\*

The second set of acronyms, in brackets, indicates in which of Sandia's mission areas the work was completed. Those acronyms are:

- NW: Nuclear Weapons • RGND: Reduce Global Nuclear Dangers • NAW: Nuclear Assessments & Warnings • Cyber: Cyberspace • SDP: Synergistic Defense Products • RG CBD: Reduce Global Chemical and Biological Dangers • SSEF: Secure and Sustainable Energy Future • LDI: Leveraged Defense Innovations • LF: Laboratories Foundations



Ryan Schultz adjusts a microphone for an acoustic test on a B61-12 system. The unit is surrounded by banks of speakers that expose it to an acoustic field. The sound pressure reaches 131 decibels, similar to a jet engine.



Sean Kearney studies jet flames with laser diagnostics to make temperature and soot measurements of the heat released from a fire onto a weapon system.

Cover photographs by Randy Montoya

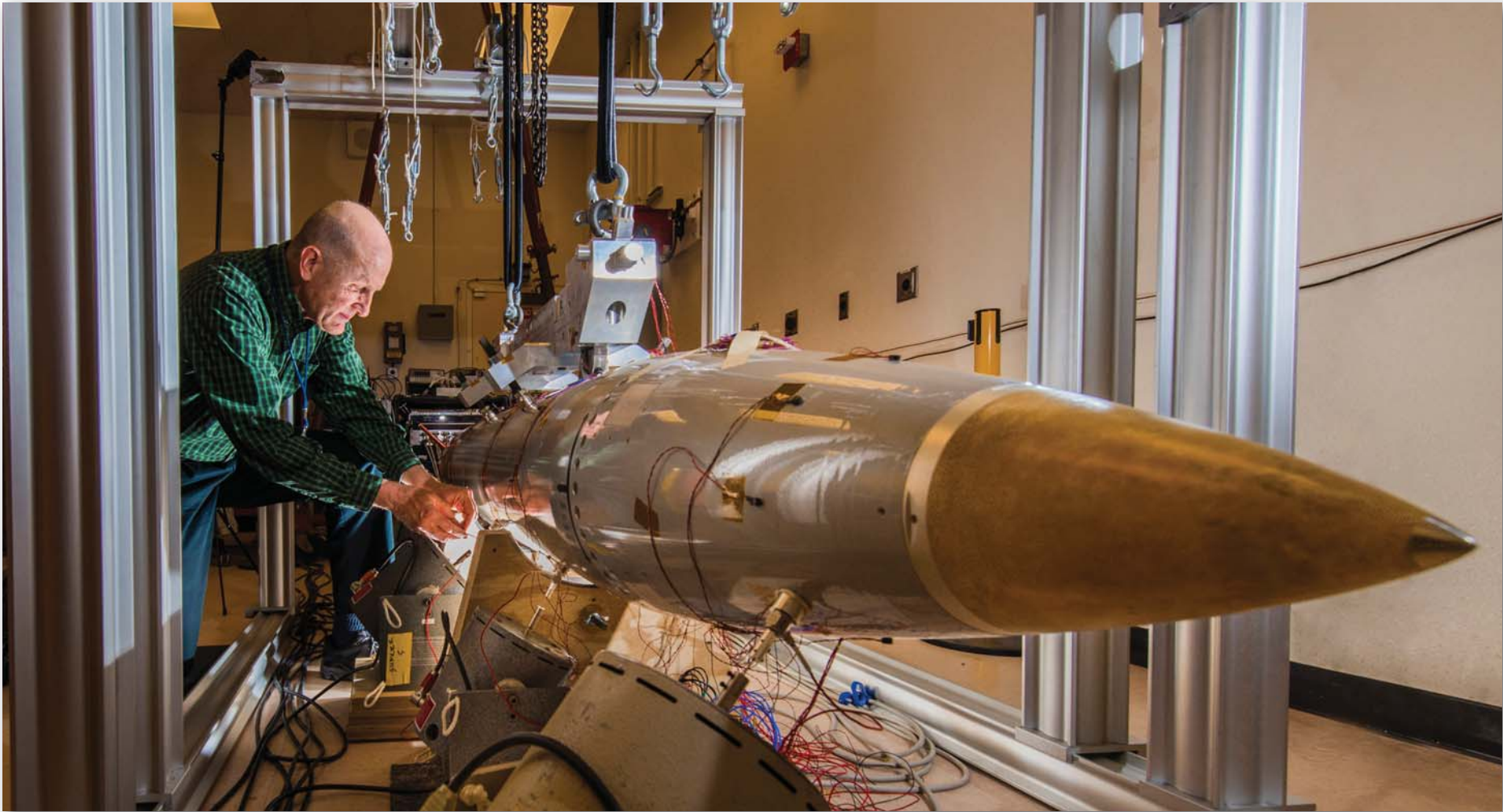


Bill Murphy • Lab News Editor  
Michael Lanigan • Labs Accomplishments Design & Production  
<http://www.sandia.gov/LabNews>  
Albuquerque, N.M. 87185 • Livermore, Calif. 94550  
Tonopah, Nevada • Nevada Test Site • Amarillo, Texas  
Carlsbad, New Mexico • Washington, D.C.

**Sandia National Laboratories**  
Sandia National Laboratories is a multiprogram laboratory operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corp., for the US Department of Energy's National Nuclear Security Administration.



# Nuclear weapons engineering



The B61-12 Life Extension Program (LEP) implemented an Earned Value Management System (EVMS) to manage cost and schedule performance. At the cornerstone of the EVMS is a fully integrated, resource-loaded master schedule detailing all Sandia work scope through 2024. Sandia nuclear weapon design, business, and IT organizations partnered to design and implement the system. More than 100 technical leads, schedulers,

and project controls analysts across the B61-12 LEP were trained to work within the EVMS and ultimately strengthened their skills and knowledge of rigorous project management. The LEP is realizing early benefits from critical-path analysis and cost and schedule integration. (2000, 1000, 5000, 6000, 8000, 9000, 10000) NW [NW]

(Photo by Randy Montoya)

With wide participation of reliability, system, surveillance, and component engineers, the B61-12 Reliability Review Panel completed its peer review of the B61-12 reliability model in July 2014. The review included validation and identification of improvement opportunities of the system model and of Sandia and Los Alamos national laboratories subsystem and component failure events — a critical part of ensuring the B61-12 system design is capable of achieving its required reliability. The validated model will be used going forward over the life of the program for reliability assessment. (400, 2100, 2500, 2600, 2700, 2900, 8200, LANL, NNSA ) NW [NW]

A cross-functional team initiated a layered defect prevention (LDP) strategy to improve product quality from design through production and acceptance. Data indicates the majority of defects originate in the requirements phase. Eliminating defects, or minimizing their impact, results in improved end-product quality and reduced life-cycle costs. Center 400 developed a curriculum around the tools of defect prevention along with a general method for implementing layered defect prevention that is available for partners around the Labs to launch their own high-consequence programs for reduction of product defects. (400, 2200, 2700) NW [NW]

The Mk21 Fuze Program is developing a replacement fuze for the Mk21 reentry vehicle that contains the W87 warhead. This Air Force-funded program reached an important milestone in FY14 with approval of the “Acquisition Program Baseline.” The APB formally established the program’s cost, schedule, and performance requirements against which future progress will be measured. This achievement was enabled by collaboration among Centers 8200 (warhead integration), 2100 (fuze design), and component design groups in Centers 2600, 5300, and 5400. (8200, 2100, 2600, 5300, 5400) NW [NW]



Daily we hear of national security threats involving insider threat, information technologies/cyber threats, and supply chain attacks. The Nuclear Enterprise Assurance Center led work on strategies and capabilities on how best to address these threats in the context of the Nuclear Security Enterprise. This work was the basis for an Enterprise-wide program established this year by Don Cook, NNSA’s deputy administrator for Defense Programs. His memorandum stated, “The underlying requirement is to design, develop, and produce all future weapons with enhanced trust features that are resilient to subversion attempts.” (500) NW [NW]

Sandia and Honeywell FM&T completed the relocation of the production capabilities for all W76-1 Life Extension Project components produced at the Bannister facility to the new National Security Campus (NSC) in Kansas City. To maintain W76-1 production capability, the move necessitated a twofold approach of build-ahead and dual-build. After the NSC production capability was fully established, the Bannister production was shut down. The teams completed the extensive relocation while still maintaining shipments of all components from the NSC to the Pantex Plant in Amarillo. (400, 1700, 2200, 2500, 2600, 2700, 2800, 2900, 5300) NW [NW]



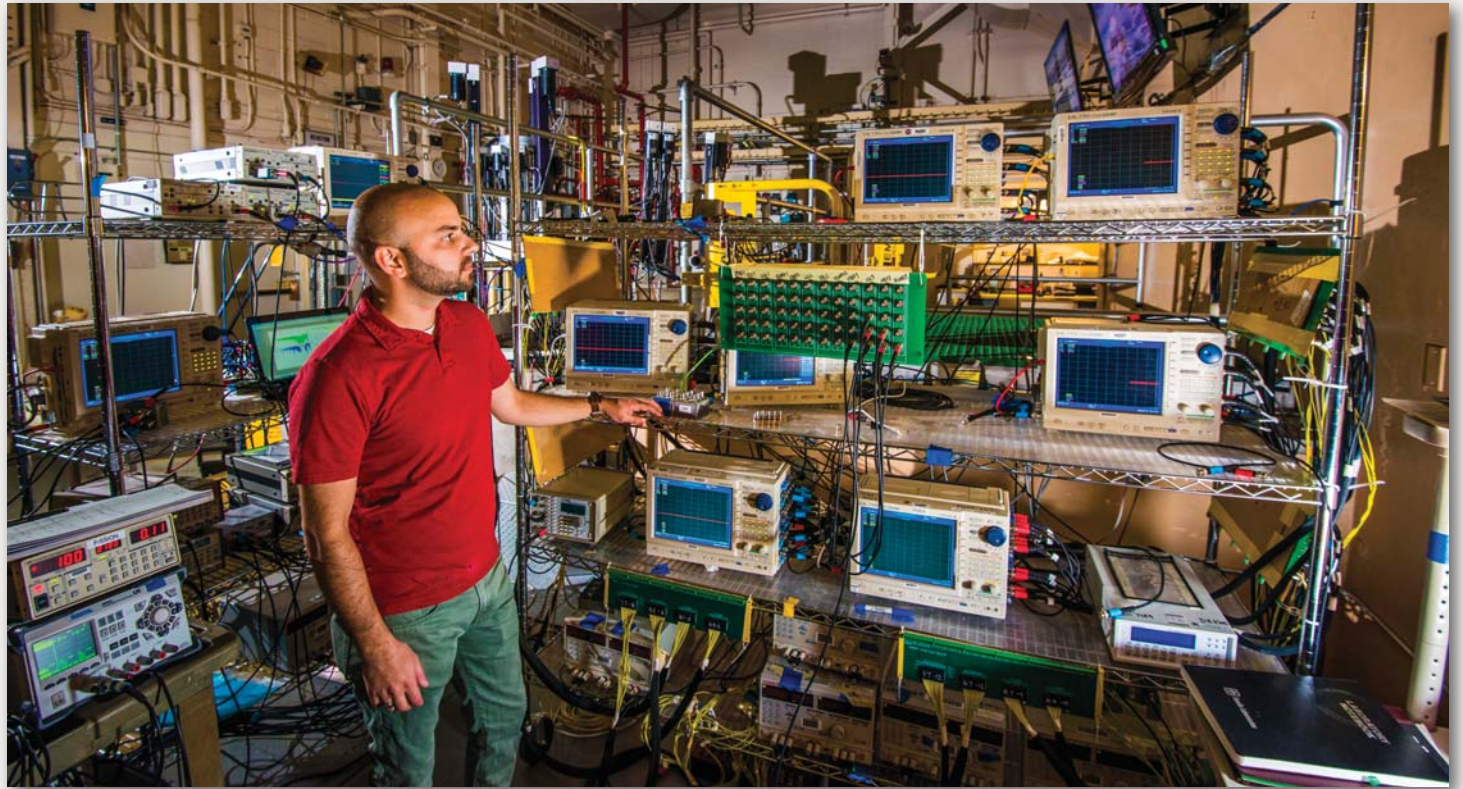
The B61-12 Program is well into the Phase 6.3 Design & Development effort. In collaboration with both internal and external partners, extensive system-level design and development activities were completed in FY14. These activities included a detailed series of electrical tests demonstrating functionality of the design. In addition, a number of thermal, mechanical, electromagnetic, flight, and materials compatibility activities have been completed. These efforts include characterization of both War Reserve (WR) and non-WR designs through physical test and modeling and simulation under relevant normal and abnormal environments. (2000, 1000, 5000, 6000, 8000, 10000, 200, 400, 500) NW [NW]



## Nuclear weapons engineering

**Under the Qualification Alternatives to the Sandia Pulsed Reactor (QASPR) project**, the first tests of a small-scale integrated circuit (SSIC) using ion beams produced by the Ion Beam Laboratory have been done at displacement damage levels comparable to the retired Sandia Pulsed Reactor. The ability of the beam to impart localized damage to single or multiple transistors has improved our understanding of the survivability of such circuits in hostile radiation environments. (1100, 1300) NW [NW]

**RESEARCHER Billy Martin (6221)** looks over diagnostics that are part of the Qualification Alternative to Sandia Pulsed Reactor program. QASPR combines computer modeling and simulation, experiments, and technology development for stockpile surveillance. (Photo by Randy Montoya)



**Sandia released B61-12 LEP Validating Information Processor (VIPr)** use control systems software culminating in successful system-level testing. The development software enabled the Systems group to exercise all of the communication channels in the weapon for use control commands, the communication channels for other components linked by the VIPr, and the critical function control switch. The VIPr is the weapon-based portion of multiple use control systems components in the B61. (2600) NW [NW]

**Sandia successfully conducted the first flight test** in the W88 ALT 370 development program in partnership with Los Alamos National Laboratory, the Kansas City Plant, and Pantex. The Critical Radar Arming and Fuzing Test (CRAFT) flight provided the environment necessary to test the new joint radar in the W88 ALT 370 reentry system. Flight data analysis confirmed success in all test objectives including plasma environment data collection and radar ranging in all radar fuzing modes. Both NNSA and the US Navy publicly recognized the importance of this technical achievement and program milestone. (1500, 2100, 2600, 5300, 8100) NW [NW]

**Additive manufacturing capabilities** were employed to design and fabricate a full-scale prototype cutaway of the B61-12. This marks the first time a full-scale cutaway has been available during Phase 6.3 of a life extension program. The unit can be reconfigured to reflect the evolving design. It can also be shown in several unique configurations to accommodate the clearance level of the viewing audience. One unit is housed at Sandia/New Mexico and a second unit was fabricated to support NNSA discussions with stakeholders in Washington, D.C. (2900, 2100) NW [NW]

**Sandia's Enterprise Modeling & Analysis Consortium team** (Org. 280) delivered the Scope and Complexity Model methodology white paper (release 2) four months ahead of plan, enabling support of the W78/88 120-Day Study and delivering all modeling and analysis products on or ahead of schedule. Using the Sandia-developed "Stockpile Optimization under a Resource-Constrained Enterprise" model, Sandia is providing primary Nuclear Security Enterprise stockpile analyses for the Production and Planning Directive 2014-1. (200) NW [NW]

**Sandia developed a new flight recorder/telemetry** for collection of critical weapon performance data in support of the B61 stockpile surveillance flight test program. The Joint Test Assembly Modernization flight recorder collects 4,000 times more data per flight than the system it replaces, allowing improved weapon assessment during surveillance missions. As a result, Sandia can collect enhanced fidelity data while testing at the edges of the aircraft's release envelope. Telemetered data at 5 Mb/sec permits real-time access to pre- and post-release data. (2200, 8100, 0400, 2600, 2700, 5300) NW [NW]

**Sandia's Aircraft Compatibility Team** and B61-12 Life Extension Program System Engineering completed Vibration Fly-Around/Instrumented Measurement Vehicle testing on the F-15E and F-16 airframes. Six flights were flown in July and August 2014. Five weapon configurations — three on the F-15E and two on the F-16 — were represented in the six flights. These tests were the first successful flights of Sandia-furnished test units on US Air Force carrier platforms. (2900, 2100) NW [NW]



**The Test Operations Center at Tonopah Test Range** underwent a modernization initiative from November 2013 to March 2014, integrating scalable/configurable flight test suites, a touch-screen VOIP communications system, new situational awareness displays for increased flight safety, and LED energy-efficient lighting. Flight test personnel now have enhanced collaboration and communications capabilities, and information flow is faster and archived more efficiently. This exponential upgrade in the Test Operations Center expands the operational capability and flexibility of this vital node for Sandia's stockpile surveillance mission and postures TTR for upcoming flight test missions. (2900) NW [NW]



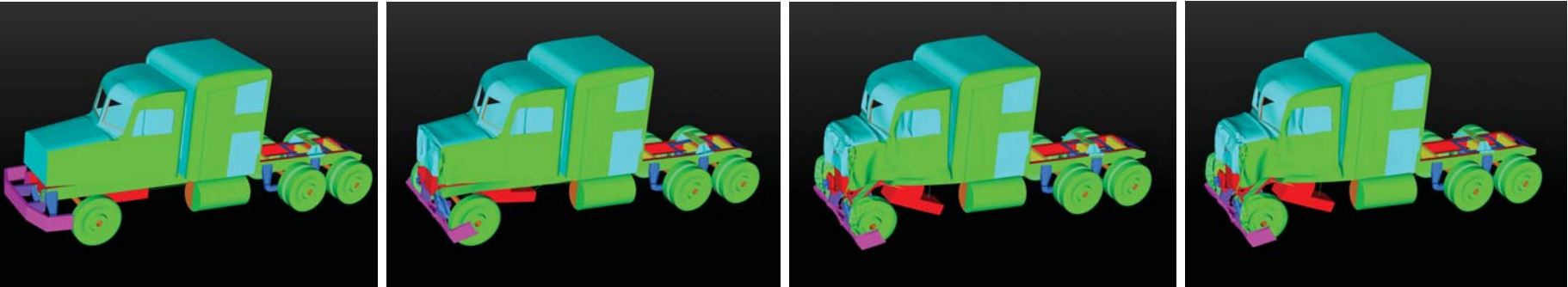
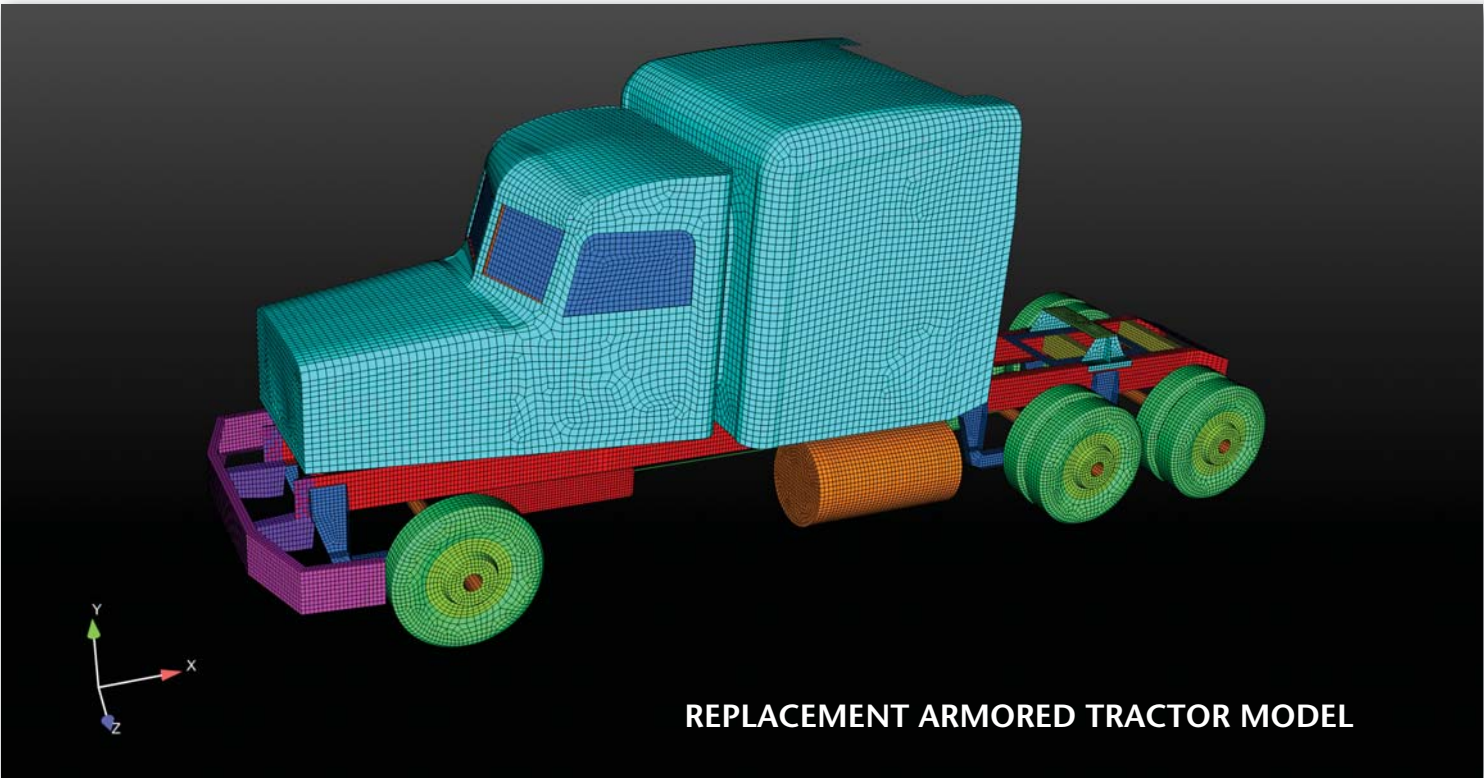
# Nuclear weapon security

The multi-agency Joint Integrated Lifecycle Surety (JILS) project uniquely delivers surety risk analysis for the nuclear weapons enterprise. The JILS team, led by Sandia, comprises experts in physical security, nuclear weapons, systems analysis, human

factors, and risk analysis, with participants from US Air Force, US Navy, NNSA, and Sandia, Los Alamos, and Lawrence Livermore national laboratories. This year, the team expanded JILS capabilities (including cost-benefit analysis) and performed refined option

analyses. The team’s risk analysis informed key surety decisions and discussions in the nuclear weapons enterprise, leading to an NNSA Defense Programs Award of Excellence. (8200, 8100, 6600, 6500, 5600, 400) NW [RGND]

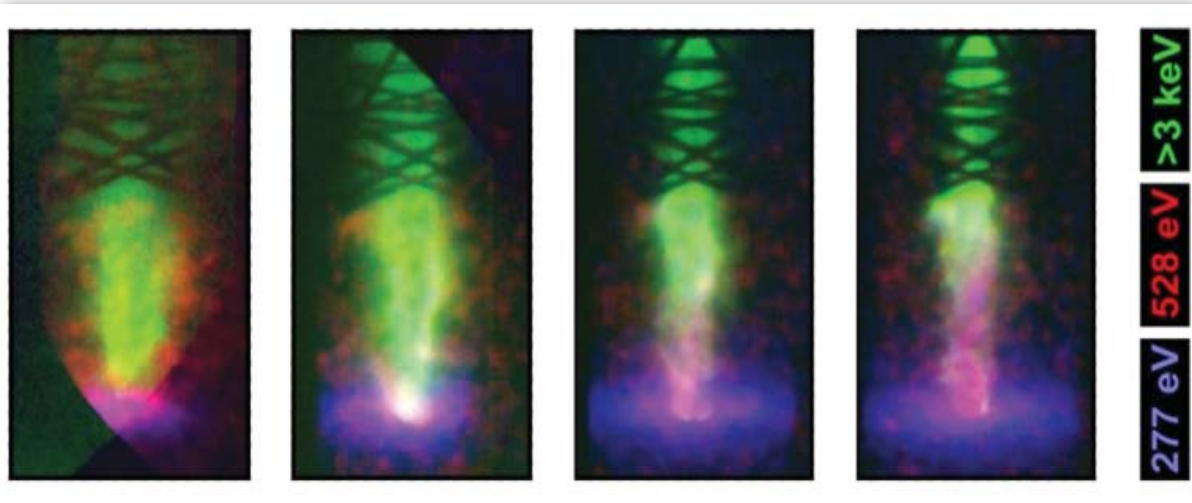
Our team conducted a finite element analysis of a replacement armored tractor used by the Office of Secure Transportation for the Safeguards Transporter fleet. We performed the analysis, using a model with more than 150,000 elements, to determine how the tractor would respond in a severe design basis accident crash. This collaborative effort, involving Centers 6600, 1500, and 400, was performed using Sandia’s advanced scientific computing resources. The results were used in support of the Nuclear Explosive Safety Study Group to confirm that the replacement tractor would perform to specifications. (6600, 1500, 400) NW [RGND]



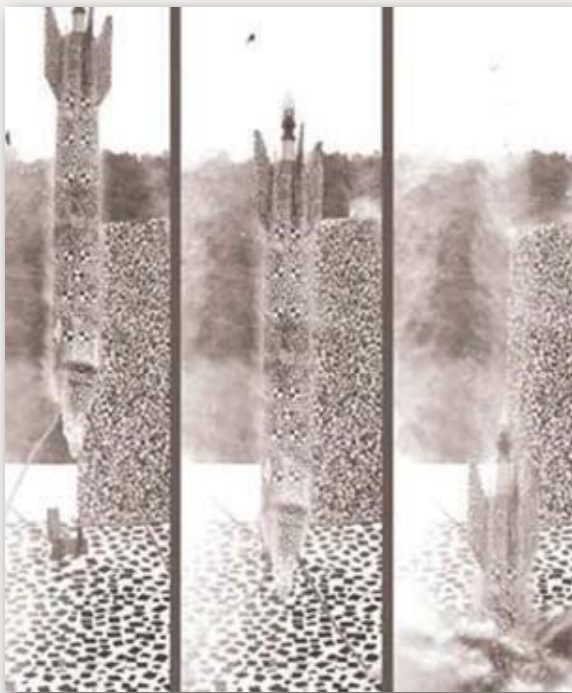
REPLACEMENT ARMORED TRACTOR under frontal impact loading. Shown above is loading sequence 1 through 4. (Computer imagery by Ken Gwinn, Michael Holle, and Kurt Metzinger)

# Nuclear weapons engineering

Sandia scientists have used the Z Machine to create the world’s brightest bursts of cold X-rays in a laboratory setting to simulate the effects of nuclear countermeasures. By imploding puffs of argon gas at high velocities, three shots in October achieved record exposures and data collection under the Radiation Effects Sciences (RES) Z campaign — a program aimed at validating physics models and engineering codes used for assessing the survivability of strategic weapons in hostile nuclear environments. (1300, 1500, 1600, 1800). NW [NW]



ONLY 2.5-CENTIMETERS TALL and lasting just tens of nanoseconds, argon implosions at Z are the world’s brightest laboratory source of cold X-rays, shown in these false-color frames calibrated to the emitted X-ray energies.



Sandia executed a B61-11 Cable Pull Down stockpile surveillance test at the Sandia Aerial Cable Facility. The test unit was pre-conditioned to the Stockpile-to-Target Sequence cold temperature extreme. Impact conditions were consistent with a low-altitude delivery. Surveillance data were interrogated from the on-board flight recorder, and post-test evaluation indicated the unit functioned normally. NW (1500, 2200, 2900) NW [NW]

Centers 1700 and 2600 completed the qualification of a critical new supplier to complete the final production lots for a Gel Mylar Capacitor. As a result of early production issues, a team was formed to develop a new supplier to finish capacitor production. The Product Realization Team built and delivered more than 100 Mark Quality capacitors to the Kansas City Plant in August 2014. This accomplishment was three-plus years in the making and resulted in four development builds and two Process Prove-In builds prior to the successful, reject-free lot submittal in August 2014. (400, 1700, 1800, 2100, 2200, 2600, 2700, 2900, NNSA, SFO) NW [NW]



## Remote sensing



THE GPS GLOBAL BURST DETECTOR payload being prepared for a system test.

(Photo by Randy Montoya)

The Global Burst Detector completed a major program milestone in November 2014 by gaining customer approval to ship the third flight system to the GPS III space vehicle contractor for integration. The Global Burst Detector, hosted on the GPS satellite, provides 24/7 Medium Earth Orbit detection and location of nuclear detonation events worldwide and builds on the successful deployment of the GPS IIF and IIR suite of satellites currently on orbit. Sandia, in partnership with Los Alamos National Laboratory, has a long history in the development and delivery of satellite-based nuclear detonation detection systems. (2600, 5300, 5700) DSA [NAW]

Recognizing Sandia's in-depth expertise in remote sensing science and operations, the US Air Force Space Command engaged the Labs to participate in the Space-Based Infrared System (SBIRS) Follow-On Analysis of Alternatives (AOA). The AOA will determine the most cost-effective

approach for performing our nation's missile warning, missile defense, and battle space awareness missions against emerging targets and technologies beyond the current SBIRS program. By guiding design options and simulating mission performance of alternatives, the DS&A PMU is

helping shape the next-generation DoD space architecture. (5000, 5500, 5300, 05700, 10600) DSA [LDI]

**Sandia successfully completed security design and installation upgrades** at a critical location. The upgrade included a Wide Area Surveillance System and Intrusion Detection and Assessment System. Working in partnership with US Air Force and under direction from the Joint Theatre Surety Management Group, Sandia met all requirements on time and within budget, and this site passed Government Acceptance Testing in July 2014. Sandia has been involved in protecting our nation's critical assets for more than 40 years. (6500) IHNS [RGND]

**Sandia's Space Mission Program has received authority for a major initiative** to develop and deliver a next-generation satellite ground system. This ground system, building on Sandia's successful history, will support generalized and extensible mission management and data processing for a new breed of persistent sensors developed by industry. The system will enable robust research and development of technologically advanced algorithms and quickly deploy them to meet rapidly changing needs of end users. (5500, 10600) DSA [LDI]

**Along with a number of Sandia partner organizations**, the Advanced Systems Program delivered a major update to a sensing ground station software system. This was the largest delivery since the original ground system delivery and concluded an 18-month development and delivery effort that resulted in the installation of three million lines of code, eight racks of computer and network hardware, and a number of significant new system capabilities. The installation effort was accomplished with just hours of system down-time, delighting the customer. (2600, 5300, 5500, 9500, 10600) DSA [LDI]

**Sandia's Airborne Intelligence Surveillance and Reconnaissance Systems group** successfully integrated the Copperhead synthetic aperture radar onto a new platform, the US Army's Hunter unmanned aerial vehicle. This quick-turn technical effort was completed in approximately four months as required to support a transition directed by the deputy secretary of defense. The successful effort was critical in extending the Copperhead Counter-IED mission through FY15. (5300, 2600, 5400) DSA [SDP]

## Product realization

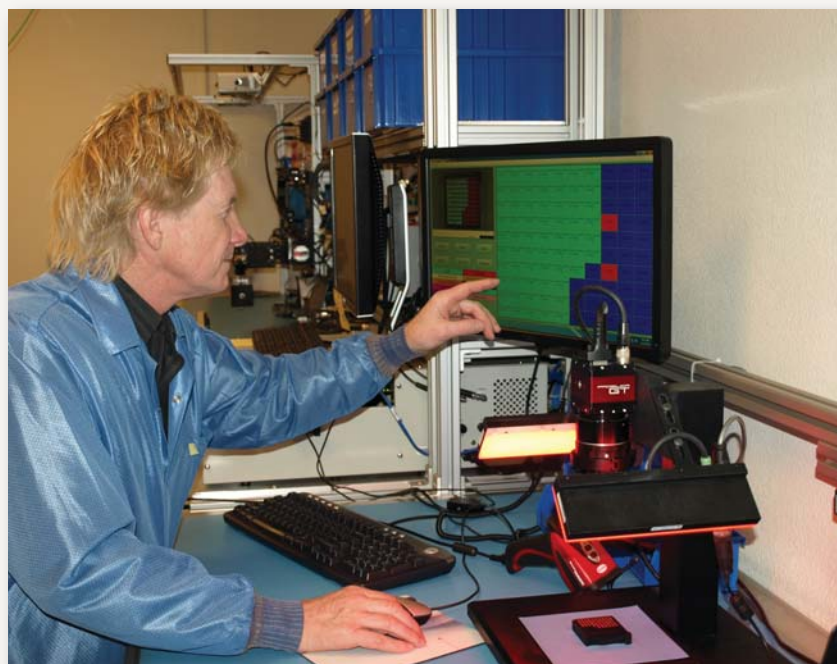
In partnership with NNSA, **Sandia's Neutron Generator Enterprise (NGE)** developed an NGE Integrated Program Plan (NIPP), a key element of customer management assurance. The NIPP communicates the approach used to plan, manage, and operate the enterprise to meet required deliverables per negotiated funding targets. In FY14, the NGE met or exceeded all production and development NIPP deliverables. A noteworthy FY14 highlight for the NGE was the realization of a \$4.5 million recapitalization gain for critical equipment needs as a result of continuous improvement activities. (2700, 2800, 2100, 2500, 8200) NW [NW]

**The B83 ALT353 Gas Transfer System** Product Realization Team overcame technical and programmatic challenges to successfully complete all deliverables, culminating in First Production Units in 2014. The team applied its strengths in metallurgy, material science, and computational analysis to address production challenges and establish a robust qualification process. The aggressive timeline necessitated outstanding communication and coordination among Sandia, the Kansas City Plant, and the Savannah River Site. The ALT353 motto is "One Team" and they have exemplified that maxim in their efforts and in their success. (8200, 8300, 8500, 8100, 1800, KCP, SRS) NW [NW]

**Center 5400 met key milestones for the B61-12 LEP** with the assembly, integration, testing, and delivery of three Compatibility Test Units (CTU-2) and seven Flight Body units (FB-2). The CTU-2 is a representation of the B61-12 used by Aircraft Compatibility (2951) to evaluate the weapons' pre-release functionality and ultimately certify the B61-12 weapon for use on the F-15, F-16, B-2, and PA-200 aircraft. The FB-2 is a representation of the front end of the B61-12 intended to support tail kit assembly development and qualification by the Air Force. (5400, 2100, 2900, 6500) NW [NW]

**The Common Engineering Environment Portal** is the first dedicated website available for engineers to access all components (i.e., processes, tools, training, best practices)

**We've built a machine-vision recognition system** for fast, error-free parts handling in support of a defect-prevention strategy for our small form-factor HBT — heterojunction bipolar transistor — products. The system removes the human operator from multiple data entry steps from package lidding to final package delivery. Human data entry now occurs only once in the product's life. The reading system uses high-resolution camera software to recognize each part in an image of an array of parts to enable our software system to interface seamlessly within an electronic production control system framework. (1700) NW [NW]



ALAN GORENZ (1766) confirms a 100 percent success rate for machine-vision reading of 2-D data matrix-encoded Sandia piece parts for full traceability supporting an electronic production control system. (Photo courtesy of Alan Gorenz)

needed to excel in the practice of engineering. The impact will lead to improved systematic quality approaches through consistency in preferred engineering practices. The Portal will result in more efficient workforce skills mobility across Sandia. The Labs may realize cost savings through corporate tool purchases including multi-user licenses. The site was created through collaboration across all PMUs via the Common Engineering Environment Steering Committee. (9010, 9500, 9300, 8900, 2200, 1500, 8200, 10600, 5500, 6500, 6900, 0100) IMS [LF]

**The final lot of the MC4698 thermal battery** for the W76-1 LEP was delivered in September 2014, free of defects. The entire production run of batteries was accomplished through a close partnership with Sandia External Production, the Sandia Quality organization, and a commercial supplier. A Lean Six Sigma approach and a concerted effort to communicate Sandia requirements were critical to meeting schedule and cost targets. The resulting collaboration has built a solid foundation for future work. (2500, 400) NW [NW]



## Global security

**Harvester underwent successful flight testing** and demonstration on both C-130H manned aircraft and MQ9 unmanned aircraft, and was officially delivered to the US Air Force, all in FY14. Harvester collects airborne debris from a nuclear explosion, enabling subsequent detailed forensic analysis of collected samples, and includes two particulate sampling pods with radioisotope identification capability and a high-sensitivity

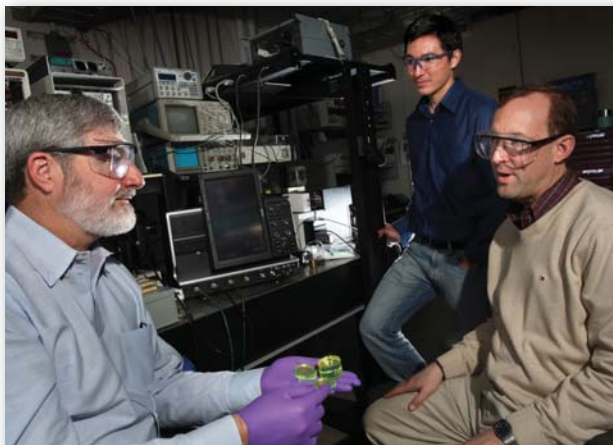
gamma directional sensor. Harvester's modular design enabled its rapid integration onto both aircraft. DoD and NA-22 supported its development by Centers 5900, 5500, and 6600. The Harvester system was a critical component of the team that won DoD's Joint Concept Technology Demonstration (JCTD) team of the year award for 2014. (5900, 5500, 5700, 6600) DSA [NAW]



SANDIA RESEARCHERS prepare pods that, airborne, will track radiation to its source and analyze particulates and gasses to identify a nuclear bomb's origin. In foreground, Eduardo Padilla (in short-sleeve shirt) and Chisom Wilson (on one knee) tune up the directional gamma radiation sensor (DGRS) pod. Scott Davison works by himself on the particulate sampling pod, while Joe Sanders (back left) inspects the Whole Air Sampling Pod (WASP). (Photo by Randy Montoya)

**Patrick Feng (8126) and his team were awarded the R&D 100 Award** for their development of Triplet-Harvesting Plastic Scintillators, funded by the DOE/NNSA/NA-221. Automated sensors are needed to screen cargo at US ports of entry for radiological materials that could be weaponized. THP scintillators give off more light at less cost, and respond faster than current scintillators. Triplet-harvesting converts energy from an organic polymer matrix to highly luminescent triplet energy states. The unique response provides the ability to discriminate threat materials from benign radiation sources. (5700, 8100) DSA [RGND]

PATRICK DOTY HOLDS EXAMPLES of Triplet-Harvesting Plastic Scintillators as lead investigator Patrick Feng, center, and Mark Allendorf contemplate their achievement. (Photo by Dino Vournas)



**Working with NA-24, NNSA's Nonproliferation & International Security organization**, members of Sandia's International Nuclear Risk Reduction department worked with Video Services to produce a short video explaining to the Indian and Pakistani populations the issues of a parallel, transparent process of dismantling obsolete missiles. The video is a documentary of young Indians and Pakistanis participating in transparency exercises (developed by Sandia) using real missiles and virtual reality tools (also developed by Sandia). Thus far, this training video has been seen on social media by more than 2.3 million people living in India and Pakistan. (6800, 3600) IHNS [RGND]

**A four-year project between Sandia's International Nuclear/Radiological Security Dept. 6811 and the South African Nuclear Energy Corporation (NECSA)** culminated in a successful physical protection assessment by a multi-agency US government team (DOE/NNSA, Department of State, and Nuclear Regulatory Commission) that will allow NECSA to receive US-origin low-enriched uranium (LEU). This effort ensures that South Africa can further reduce the potential of nuclear proliferation as well as provide a stable supply of LEU-produced medical isotopes for the world market. (6800) IHNS [RGND]



THIS SAMPLE displays the variety of colors that can be produced in anti-tamper indicators on metals. (Research supported by Defense Threat Reduction Agency)

**Because conventional markings and seals** can be duplicated or counterfeited, Sandia materials researchers have developed a patented process to create trusted tamper-indication markings using pulsed lasers. This process creates unique, non-reproducible color patterns and features to determine whether a component has been compromised. On metals that oxidize, intrinsic, microstructurally unique color patterns and one-of-a-kind features are formed, while on materials that do not oxidize, distinctive periodic ripple patterns are formed that cannot be replicated. This commercially viable technique can be used to readily authenticate components. (1800, 1500, 2600, 6800) NW [NW]

## Cybersecurity

**Sandia Cyber Omni Tracker (SCOT)** is a state-of-the-art cyber security incident response system and knowledge base. Released as open source, SCOT was selected by the Department of Homeland Security Transition to Practice Program as a new technology to help the nation respond to cybersecurity challenges. Designed by cybersecurity specialists, SCOT provides an innovative approach to performing cyber analytics and correlating disparate data to enable deeper insight to cyber adversaries and threats. SCOT creates actionable intelligence from existing security applications, thus enhancing overall cyber protections. (9300) All PMUs [Cyber]



ADRIAN CHAVEZ

**Adrian Chavez (5629) has been named by President Barack Obama as a recipient** of the Presidential Early Career Award for Scientists and Engineers. The award is the highest honor the US government bestows on scientists and engineers who are beginning their careers. His research has focused on developing and integrating new cybersecurity protections into systems like the US power grid, oil and gas refineries, and water pipelines, to ensure they can survive cyber incidents while sustaining critical functions. Adrian and his team are working on dynamically defending and randomizing critical infrastructure networks, essentially turning them into moving targets, making it more difficult for an adversary to locate and exploit a specific system.

## ES&H & security

**As part of the Security & You Transformation Strategy, several initiatives were developed** in FY14 to cultivate partnerships and open dialogue between the Security program and the workforce. Division Outreach concentrated on opening the lines of communication between Security and each division's VPs, directors, and senior managers. The Security Incident Advisory Panel incorporated division representatives from all levels of the workforce to team on determining effective incident reduction activities. Additional initiatives included improved security training, security learning minutes, and newsletters as well as the "Security Salutes" workforce recognition program. (4200) IMS [LF]



PAULETTE SOLIS

**Paulette Solis (4249) was named as the contractor recipient** of NNSA's Bradley A. Peterson Security Professional of the Year Award. Each year, this award recognizes one contractor and one federal employee whose contributions to security programs in the NNSA enterprise exemplify excellence and commitment. NNSA acting Chief and Associate Administrator Doug Dearolph noted, "Ms. Solis exemplif[ies]

NNSA's commitment in improving and enhancing its security across the enterprise. I applaud the dedication of . . . Paulette for [her] commitment in helping to protect NNSA's resources. Our security culture continues to see improvement in accountability and vigilance as we continue to implement controls that expand accountability and cooperation across the enterprise."

Paulette received the award based on her outstanding leadership activities and efforts that resulted in cost savings and avoidances of nearly \$500,000 while reducing facility clearance rejections and improving processing times.



## Bioscience

**BaDx (*Bacillus anthracis* Diagnostics)** is a stand-alone, compact diagnostic device for use in resource-limited environments to detect real-world concentrations (>100 spores) of virulent *B. anthracis*, the causal agent of anthrax. BaDx integrates a micro-culture chamber, selective media, and lateral-flow assay diagnostic components into a single-use package with a “self-destruct” feature for safe device disposal after anthrax detection. This 2014 R&D 100 Award-winning technology provides a safe, rapid, and simple means to accurately detect anthrax without expensive or complicated laboratory equipment. (1100, 1700, 6800, 8600) LF [RGCBd]

SANDIA SCIENTISTS, from left, Jason Harper (8631), Melissa Finley (6825), and Thayne Edwards (1714) show a BaDx anthrax detector. The three were recognized by the Federal Laboratory Consortium for their work in commercializing the BaDx technology. The detector was licensed by a New Mexico company.

(Photo by Randy Montoya)



## Computer & information sciences



MARK TAYLOR, ACME's Chief Computational Scientist, stands in front of a visualization of a high-resolution simulation showing atmospheric flow patterns and water content.

(Photo by Randy Montoya)

Sandia is applying its extensive experience in high performance computing environments, software engineering, and uncertainty quantification to aid development of DOE's next-generation climate and Earth system model, which will be used to address the most challenging and demanding climate change issues. This new program, Accelerated Climate Modeling for Energy, or ACME, is developing a state-of-the-science Earth system model that will run efficiently on DOE leadership computing facilities to address DOE scientific and energy applications. Sandians serve as ACME's chief computational scientist and ACME's software engineering lead. (1400, 6900, 8300) EC [SSEF]



(Photo by Stephanie Blackwell)

EDWARD JIMENEZ

Edward Jimenez Jr. was recognized by Great Minds in STEM (Science, Technology, Engineering, and Math) as “Most Promising Engineer or Scientist — Advanced Degree, PhD.” His award was presented at the 26th annual Hispanic Engineering National Achievement Awards Conference in New Orleans. Edward received this award in recognition of his exceptional leadership, innovative research, and commitment to the community while continually demonstrating integrity, technical knowledge, excellent communication skills, and superb teamwork, especially in nurturing the development of future scientists and engineers.

Sandia conceptualized, designed, and prototyped an advanced analytics and visualization environment to support national cybersecurity applications. The prototype flexibly aggregates an array of live data feeds and filters and displays the information in an interactive visualization environment. The project advances national analytics capabilities for protecting high-consequence networks and cybersystems, identifying trending cyber threats, and assessing cyber defense state-of-health. (8900) IHNS [Cyber]

The Institutional Computing program made strategic and tactical investments in FY14 to support new areas of computing interest expressed by organizations across the Labs. Basic computer science research, emerging technology demonstrations, emulations of large complex systems, and data analytics are interest areas supported by the purchase of the cloud-based Dark Nebula system. Other specialized platforms for graph analysis and big data problems are in service, as is an expanded Dark Bridge system that represents Sandia's capability solution for the National Security community. (9300, 1400) All PMUs [LF]

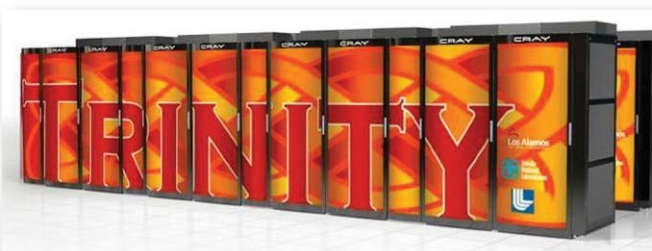
Sandia developed SNLSimMagic, an augmented reality iOS application that can be downloaded to an iPhone or iPad. If users scan an image in the Sandia High Performance Computing Annual Report using SNLSimMagic, a movie clip of the relevant computer simulation will play on their device. This app, available through the Apple Store [<http://tiny.sandia.gov/kdizf>], was recently demonstrated at Supercomputing 2014 in New Orleans. (6900, 9300) [LF, Cyber]



GETTING FOCUSED — Students rise to the challenges presented to them during a Tracer FIRE cyber defense exercise. The students visited Sandia under a DOE-funded pilot project to help students in minority-serving institutions improve cybersecurity education.

(Photo by Randy Montoya)

The Trinity supercomputer is designed to provide increased computational capability for the NNSA Nuclear Security Enterprise. Trinity's capabilities are needed to support the Stockpile Stewardship program's certification and assessments to ensure the nation's nuclear weapon stockpile is safe, reliable, and secure. Trinity is the first of the Office of Advanced Simulation and Computing's Advanced Technology systems. Trinity's features include high levels of processor parallelism, multi-level memory, tightly coupled non-volatile storage, and fine-grain power management. Additional information can be found at <http://trinity.lanl.gov>. (1400) NW [NW]



THE TRINITY SUPERCOMPUTER is designed to provide increased computational capability for the NNSA Nuclear Security Enterprise in support of ever-demanding workloads.



## IT, networks, & facilities

In March 2014, the Test Capabilities Revitalization (TCR) Phase 2 achieved its final project milestone, finishing work begun in 2005. TCR Phase 2 addressed critical infrastructure and equipment needs in 26 facilities, including the 10,000-foot sled track facility, the large-scale centrifuge facility, the mechanical shock facility, and the two large-scale vibration facilities. Per NNSA, the project met all of its performance goals related to cost, schedule, and scope and was completed \$9.1 million under the approved total project cost budget. NW [NW]



SANDIA'S CENTRIFUGE TEST COMPLEX simulates weapon system launch and re-entry environments including acceleration, deceleration, and vibration. Glenn Yarborough inspects the centrifuge arm, while Orlando Abeyta (left) and Ed Romero work above. (Photo by Randy Montoya)

**Bldg. 730** was built at the intersection of 9th Street and K Ave. in Tech Area 1. It was the third of five institutional assets constructed with Integrated Mission Support funding, per an FY12 agreement by the Laboratories Leadership Team. It incorporates lessons learned from Bldg. 704. Construction ran from August 2013 to July 2014. The building provides offices and light laboratory space to benefit ongoing science and technology activities, major S&T program initiatives, and multiple mission elements. The project was completed within budget, on schedule, and with zero safety incidents. (2900, 4200, 4800, 9300, 10200) IMS [LF]

An ongoing project to replace the existing evaporative coolers with refrigerated rooftop air conditioners for Bldg. 963 was combined mid-project with a task to prepare the building for the installation of a new test chamber used for electrostatic discharge experiments. Work on both projects

was sequenced and protective structures were provided to allow users to continue their mission work with minimum disruption. Both projects were completed on time and more than \$100,000 under budget. (4800) NW [NW]

**The Facilities Management and Operations Center's Fire Protection and Assurance** Dept. 4879 recently developed the fire protection requirements contained in Sandia's new ChemPro application. This Oracle storefront purchasing application establishes a control point for the purchase of chemicals and helps ensure compliance with numerous federal, state, local, and corporate requirements. To ensure chemical quantities comply with applicable fire code requirements, the ChemPro application interfaces with the FMOC's Maximum Allowable Quantity tool. FMOC fire protection engineers review all chemical requests for fire protection compliance and approval. (4800) IMS [LF]

**Facilities' Partnership and Planning** Dept. 4853 and Earth System Analysis Dept. 6926 developed Sandia's Institutional Transformation (IX) model, a tool that evaluates energy conservation and solar renewable energy projects at both the building and campus level. The IX system links a series of models to evaluate more than 30 energy conservation measures across building types (for example, labs and offices), technical area, or time. Sandia is using the IX model to inform capital funding and policy decisions. (4800, 6900) IMS [LF]

**The Videoconferencing and Collaborative Technologies** team initiated an effort to improve customer experience using state-of-the-art technology. The infrastructure was redesigned to allow more fluid integration with internal and external customers. Ten public videoconferencing rooms across Sandia were upgraded to take advantage of the new infrastructure, which meets the Videoconferencing Common Operating Environment. The rooms are equipped with high-resolution LCD displays and easy-to-use handheld remotes. Public rooms continue to be upgraded in FY15 and we're working with private room owners to upgrade to the same technology. (8900) IMS [LF]

**The Sandia/New Mexico Technical Library** provided significant contributions to DOE's Scientific and Technical Information Program. Transitioning to web services, more than 13,000 scientific and technical information items emanating from Sandia were submitted to the program. Sandia is the first laboratory to complete this transition, establishing a modern, efficient process for current and future submissions, while setting the bar high for other national laboratories to follow in ensuring a comprehensive Scientific and Technical Program is in place for their sites. (9500) IMS [NW]

**Significant progress implementing the Sandia/California** Site Development Plan was made in FY14. Among Facilities' projects completed are: C912 North Wing second floor was modernized for future use; C905 was seismically retrofitted for personnel safety; C927 was demolished, removing substandard space; multiple building mechanical equipment and associated control systems were refurbished for efficient use; the west side parking lot was renovated for enhanced safety; and the Livermore Valley Open Campus entrance was established for visitors. (8100, 8200, 8300, 8500, 8600, 8900) IMS [LF]



A FACILITIES MANAGEMENT ELECTRICIAN installs new electrical equipment in an Area 1 building.

**The Facilities Management and Operations Center (FMOC)** executed significant, complex, and highly accelerated projects to replace outdated electrical equipment (switchgear and panel boards) leading to the major utility and building systems for several buildings in Tech Area 1. Since the electrical equipment could no longer be adequately maintained, the renovations were completed to help reduce the risk of major unplanned and extended utility outages that could affect mission work. The project also improved the safety of electrical equipment, including a reduction in arc-flash hazard potential. (3000, 4000, 6000, 10000) IMS [LF]

## Partnerships & alliances

Sandia and the University of New Mexico's jointly developed protocell technology was licensed to startup Alpine Biosciences in July 2014. Oncothyreon Inc. subsequently acquired Alpine Biosciences in August. The license and acquisition will accelerate the technology's clinical development for treating currently intractable diseases. UNM led licensing for cancer therapies while Sandia retains rights to seek partners for national security applications. Sandia and UNM will share in any royalties that result from successful commercialization. The Sandia-UNM relationship is a partnerships model Sandia will replicate with other university partners to increase IP deployment. (1900) IHNS [RGCB]D]

## Military programs

**The RF Toolkit** provides a 3-D visualization environment for complex radio frequency (RF) analysis, including modulator/demodulator simulation, link margin calculation, multipath effects modeling, and telemetry receive-site optimization. The RF Toolkit has been used to rapidly analyze both Work for Others-related range assets and nuclear weapons development telemetry transmitter/receiver performance. It also has been used to visualize real-time missile and payload dynamics in conjunction with data provided from the Telemetry Analysis and Visualization Suite (TAVS). (2600, 5400, 2100) DSA [LDI]

**Sandia's Kauai Test Facility (KTF) in Hawaii** supported critical US missile and air defense programs during 2014. In May, KTF supported the Navy's assessment of an Aegis sensor. In July, KTF staff supported DoD's evaluation of next-generation GPS hardware. Later in the year, KTF partnered with the Missile Defense Agency in a campaign to advance the Aegis Ballistic Missile Defense system. KTF provided MDA with launch support for targets that were tracked and intercepted by the Aegis weapon system. Sandia's test and launch facility coordinates assembly, integration, test, launch, and data collection to support various ground and flight test missions. (5400) DSA [LDI]



LAUNCH OF A MEDIUM RANGE ballistic missile Type 3 target in support of a 2014 Missile Defense Agency mission. The target was launched from Kauai Test Facility Pad 42.

## Supply chain

As part of a multiyear effort between divisions, the Life-cycle Materials Management Team led the implementation of the Sandia Purchasing Storefront, an automated review and approval system for the acquisition of hazardous/controlled products such as chemicals. Implementation of the storefront was critical in demonstrating sustainable materials management to address accumulation of excess and legacy hazardous materials. In addition, legacy chemical reductions were vigorously addressed by all divisions with chemical holdings. (10200, 4100, 9500, 2500, 1300, 4800) IMS [LF]

**Supply Chain (10200)** continues to be a leader in DOE/NNSA's complex-wide acquisition initiatives. Supply Chain is actively engaged in leveraging pricing discounts for site-wide purchasing agreements. Sandia's Supply Chain was presented the Award of Excellence by NNSA's Supply Chain Management Center for its strategic savings achievements in FY14. Sandia's cost savings exceeded those of all other sites in the complex with \$57.7 million in strategic savings, or 45 percent of the complex total. (10200) IMS [LF]



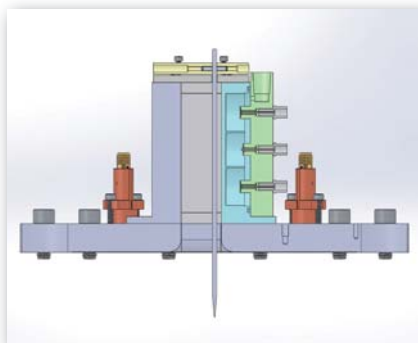
## Pulsed power

We have developed a conceptual design of Pluto, a novel accelerator that will be powered by next-generation pulsed-power technology. Pluto will deliver 3 terawatts in a 50-nanosecond pulse to advanced particle-beam diodes. (For comparison, the installed electrical power generation capacity in the US is 1.1 terawatts.) The accelerator, designed using the principles of engineered safety, eliminates hazards such as high-power lasers and asphyxiating gases that are inherent to conventional pulsed power. The accelerator will drive a variety of experiments in support of Sandia's national security mission. (1600) NW [NW]

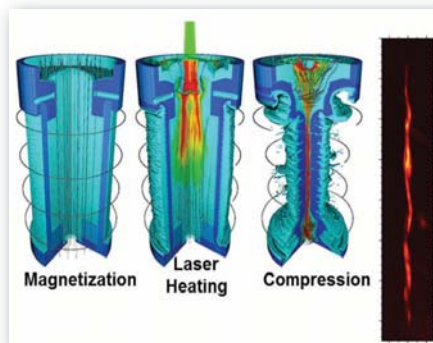
CONCEPTUAL DESIGN of Pluto accelerator.



A thorough understanding of the mechanical behavior of plutonium during strong compression remains a central stockpile stewardship goal. In collaboration with Los Alamos National Laboratory researchers, we completed the 11th and 12th contained plutonium shots since the 2009 refurbishment of Z. One of the shots required a successful extension of the authorization basis for contained plutonium experiments, since it produced an asymmetric mechanical load. This experiment further improved our understanding of the plutonium phase diagram by providing an 80 percent pressure increase applied to the plutonium over previous Z tests. (1600) NW [NW]



LOAD ASSEMBLY for asymmetric plutonium experiment on Sandia's Z-machine.

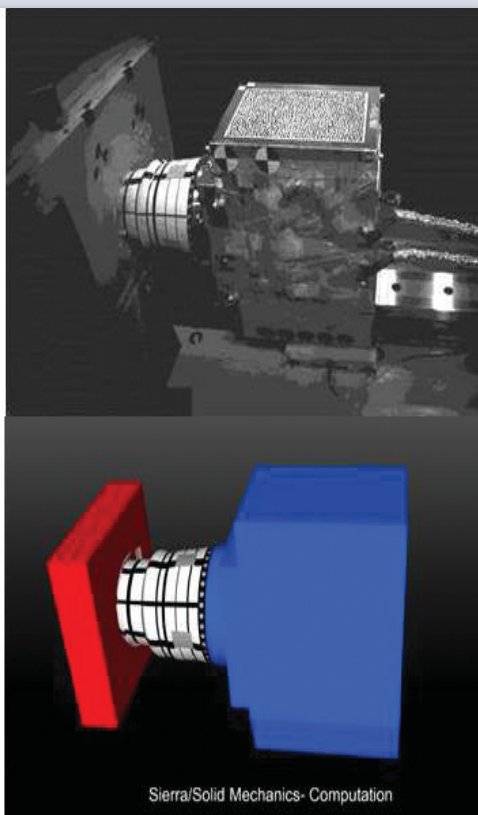
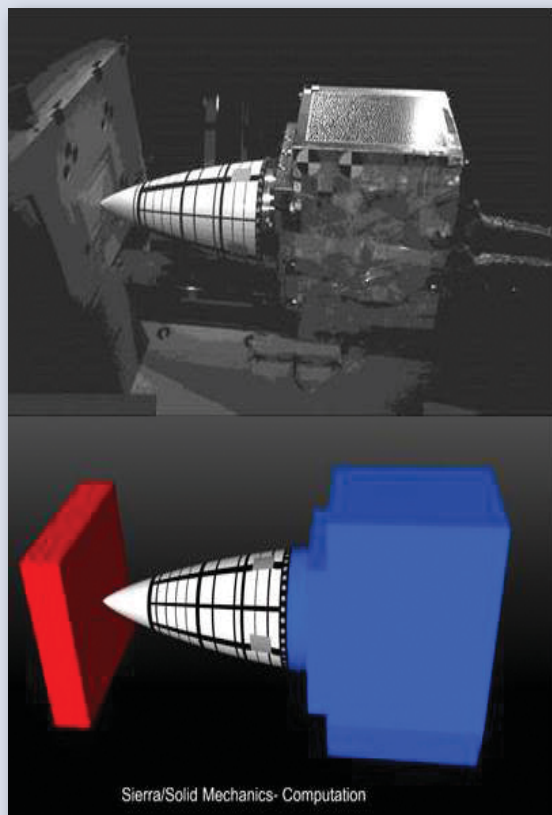


THE THREE STAGES of MagLIF. Fusing plasma seen in the experimental image on the right.

After years of preparation, the first Magnetized Liner Inertial Fusion (MAGLIF) experiments were conducted on Z. This new concept for pulsed power-driven fusion combined magnetic field confinement with laser heating of deuterium fuel during a "slow" implosion in Z. The initial experiments were successful in achieving fusion temperatures ( $>30,000,000$  K) and characteristic neutron yields and time-of-flight spectra. The results validated the primary premise to demonstrate the fuel was highly magnetized during implosion. These exciting results were published in two *Physical Review Letters* papers in September. (1600) NW [NW]

## Engineering sciences

Computational Simulations are being used at unprecedented levels to support our nuclear weapon programs. In FY14, Sandia's Sierra Suite had approximately 300 users, 1.6 million runs, and 2 million CPU-days on Sandia machines. These simulations spanned thermal and thermal-mechanical problems, captive-carry aero-structural, mechanical drops and impacts, and fuzing applications. Complex phenomena are part of the simulations, including organic foam decomposition, material fracture and fragmentation, large deformations, nonlinear material response, and coupled multi-physics. Successes include simulations related to the B61-12 and W88 programs. (1500) NW [NW]



Centers 1500 and 2100 partnered to complete a wind tunnel test series on a full-scale mock unit representing the aerodynamic characteristics of the B61-12 gravity bomb. The testing took place at US Air Force's Arnold Engineering Development Center in Tennessee, which has the nation's largest wind tunnel capable of the required air speeds. The tests established the configuration that will deliver the necessary spin motion of the bomb during freefall and mark an important milestone in the B61 Life Extension Program. (1500, 2100) NW [NW]





## Microelectronics & microsystems

Sandia researchers performed the first-ever demonstration of magnetic mirrors operating at infrared wavelengths. The mirrors are made from specially designed dielectric metamaterials and reflect light through interaction with light's magnetic field — a very unusual behavior that leads to strong electric fields at the mirror surface. These new mirrors can be exploited for applications ranging from spectrally selective infrared sensors to high-efficiency optical emitters. The Sandia team used a state-of-the-art ultrafast infrared laser system to directly observe the magnetic mirror effect. (1700) DSA [LDI]

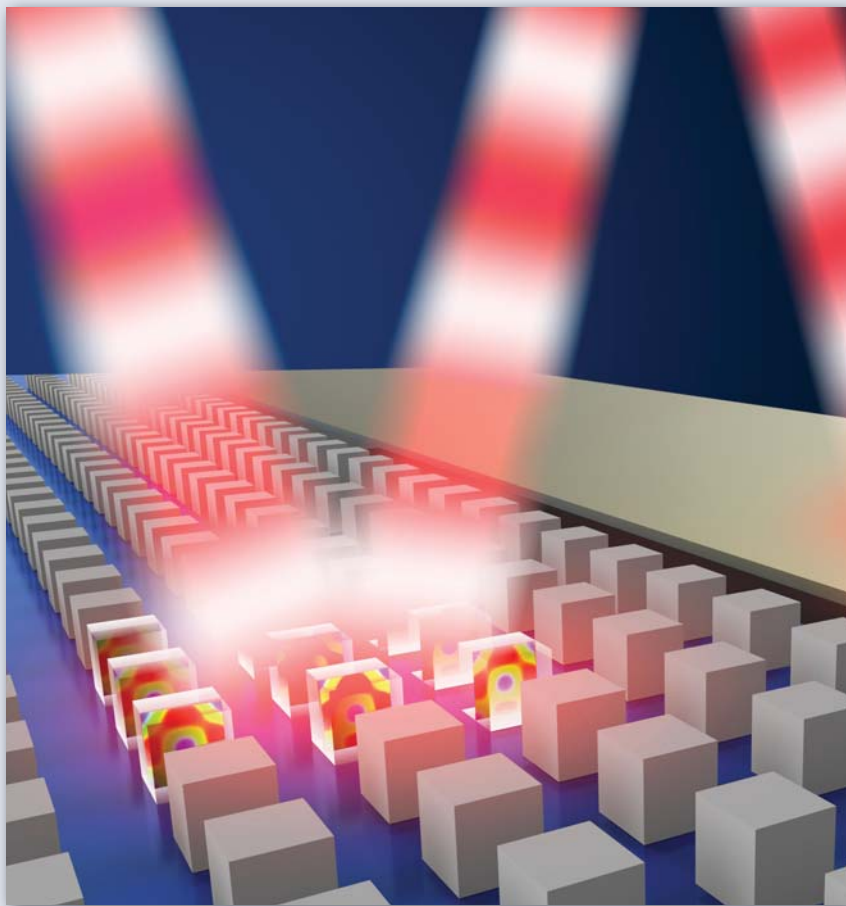
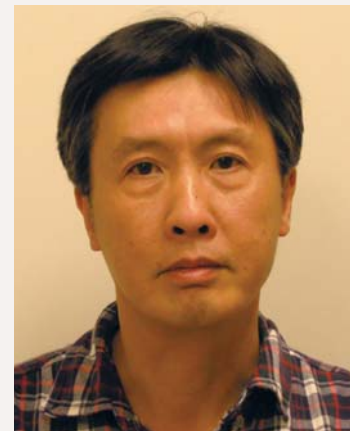


ILLUSTRATION of the operation of all-dielectric optical magnetic mirrors compared to a gold mirror. Unlike the gold surface (right), the cubic dielectric resonators (left) do not induce a phase shift of the reflected electric field at the magnetic resonance.



PAIBOON TANGYUNYONG

**Paiboon Tangyonyong (Pai)**, the co-inventor of a new technique for counterfeit detection of integrated circuits, is the person most responsible for its development, understanding its underlying science and discovering new applications. He has demonstrated the technique to multiple visitors,

including the assistant secretary of defense for research and engineering and the Government Accountability Office's chief scientist. He has also shown the technique's capabilities at other government agencies that plan to implement it. The technique was briefed to congressional committees. This latest accomplishment in counterfeit detection continues a long history of contributions to the field of Failure Analysis (FA), where Pai is recognized as a world expert in laser-based FA techniques. He has applied these techniques for localization of defects in semiconductor devices manufactured at Sandia for multiple applications. In the past few years, Pai has assumed a consulting role and mentored new staff for FA technology and product support in MESA.

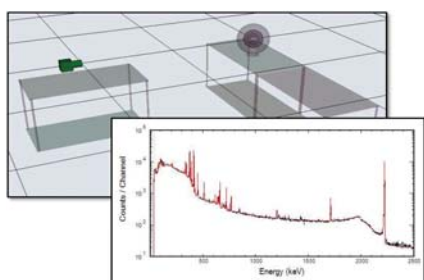
## Homeland security

Sandia's Protective Force has been the benchmark for leading the way with Active Shooter Response capabilities. In line with DOE's emphasis on preparedness vs. active shooters and other emerging threats, Sandia conducted multiple Active Shooter exercises in FY14 including a successful demonstration for the Security Oversight Subcommittee. These exercises integrated emergency processes and response capabilities to quickly respond and protect Sandia's greatest resource, its people. Additionally, to provide improved protection of the workforce, Sandia's California Protective Force implemented improvements to bring their Active Shooter response program in line with the majority of DOE laboratories. (4200) IMS [LF]



PROFORCE responds during an Active Shooter exercise. (Photo by Randy Montoya)

The Gamma Detector Response and Analysis Software (GADRAS) was modified to compute gamma-ray spectra from 3-D representations of radiation sources using analytic functions that execute several orders of magnitude faster than previous methods. The external environment is treated as an extension of a detector response function, which eliminates errors encountered when radiation transport codes interface with non-integrated detector response functions. The computational accuracy for numerous benchmark measurements is excellent. Hundreds of staff members at the national laboratories use GADRAS for predictive modeling and analysis. (6600) IHNS [RGND]



COMPARISON of a computed gamma-ray spectrum with a measurement of a plutonium sphere within a polyethylene moderator with steel tables supporting the radiation source and the high-purity germanium detector.

The Emergency Response Application Team developed X-ray Toolkit, an X-ray image processing and analysis application. XTK improves bomb technician safety by increasing operational efficiency, reducing event resolution time, and reducing time spent near the device. XTK, first developed for DOE, is now, with more than 5,000 users, the most widely used X-ray application for US military and civilian bomb squads. The FBI Hazardous Device School (HDS) now requires XTK proficiency for bomb technician certification. XTK is available on multiple platforms, including Windows XP/Vista/7/8, Android, iOS, and OSX. (6500, 6600, 9500) IHNS [RGND]

Multi-platform XTK



We have demonstrated the passive detection of a neutron source equivalent to a significant quantity of weapons-grade plutonium at a standoff distance of 100 meters using a novel detection system. This breakthrough relies on two innovations: neutron-sensitive scintillator detectors larger than 25 liters that maintain high detection and identification efficiency; and a technique to encode information about a source's direction via time modulation. This is a first with a deployable system, establishing this Sandia technology as a useful tool for countering nuclear terrorism and smuggling. IHNS [RGND]



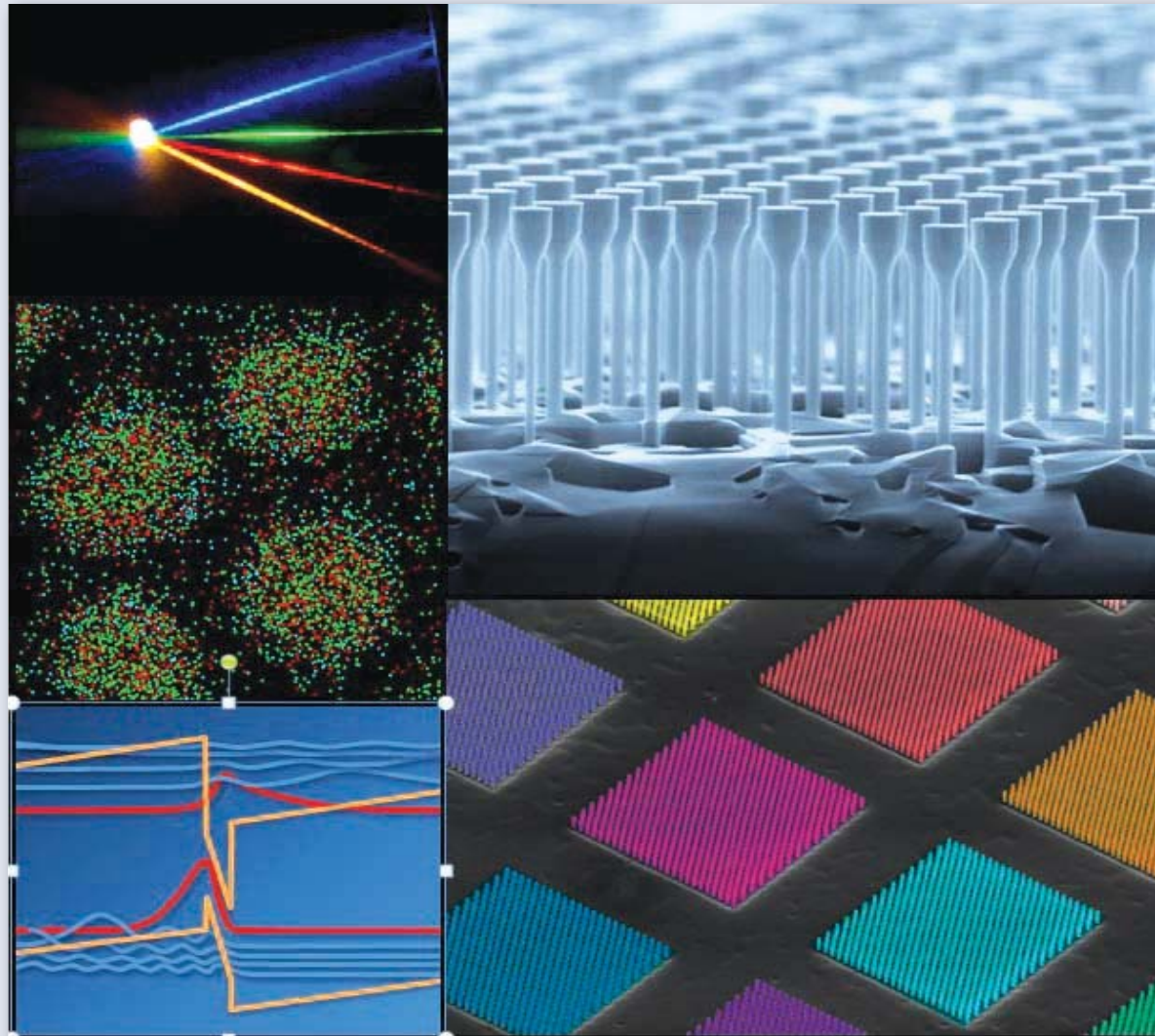
THE TIME-ENCODED imaging system installed in a 20-foot trailer for field tests, including the detection of a special nuclear material equivalent source at 100 meters via its fission neutron signature.



## Energy

Sandia's five-year Energy Frontier Research Center for Solid-State Lighting (SSL) science concluded in 2014. The overarching theme of the center was "exploring energy conversion in tailored nanophotonic structures." Major accomplishments included synthesizing new core/shell quantum dots with efficient light emission, creating a microscopic model to explain LED efficiency

limits, perfecting a new optical diagnostic tool to identify microscopic defects in working LEDs, demonstrating that lasers are a viable option for creating ultra-efficient SSL, and inventing a new approach to nanostructure fabrication — quantum size-controlled photoelectrochemical etching. (1100, 1700, 1800, 8300) EC [SSEF]



Clockwise from upper left: blue, green, red, and amber lasers combined to produce white light (Photo by Randy Montoya); nanowire LEDs; photonic-crystal laser arrays; calculated quantum-well wave functions; composition of CdSe/ZnSe quantum dots (Cd red, Se green, Zn blue).

Sandia has pioneered the area of microsystems-enabled photovoltaics (MEPV), which consist of independently wired, microscale PV cells with microscale concentrating lenses, enabling shade tolerance and coarse sun tracking. MEPV will reduce the overall system cost of PV systems by a factor of two to three by using less high-cost PV material and by using it more efficiently. Greg Nielson (1719) presented this research as a keynote address to the ARPA-E Microscale Concentrated Photovoltaic Workshop in May 2014. (1700, 1100, 6100, 1500) EC [SSEF]

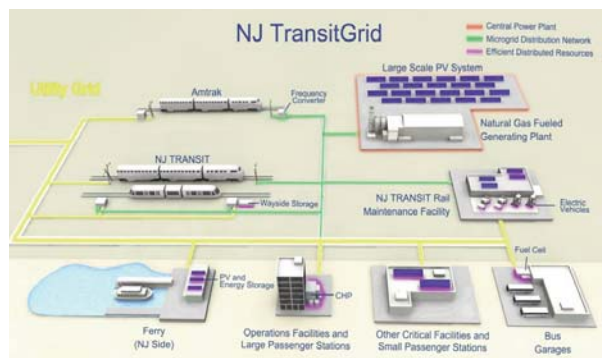


Hydrogen Fueling Infrastructure Research and Station Technology

Sandia and the National Renewable Energy Laboratory were selected by DOE to co-lead the Hydrogen Fueling Infrastructure Research and Station Technology (H2FIRST) project. Designed to help solve the infrastructure challenges that fuel cell electric vehicles face, H2FIRST will provide world-class technical facilities to demonstrate H2 refueling technologies and infrastructure. It will also work to reduce the cost and time of new fueling station construction and improve the stations' availability and reliability. While drawing upon the Labs' broader H2 expertise, Sandia's Center for Infrastructure Research and Innovation (CIRI) will serve as one of H2FIRST's primary hubs. (8300) EC [SSEF]

Research at Sandia is enabling the design of resilient electric infrastructures to minimize the impacts of major events such as those caused by Hurricane Sandy in 2012. Sandia partnered with New Jersey Transit on the conceptual design of New Jersey TransitGrid, a microgrid to main-

tain electric train service in the region. This project resulted from a memorandum of understanding signed by DOE, the state of New Jersey, and AMTRAK. Sandia's design input was the basis for a Federal Transit Administration award funding a majority of the work. (6100) EC [SSEF]



THIS APPROXIMATELY 100MW microgrid will provide power to regional rail transportation around Newark, New Jersey, and connecting into Manhattan during blackouts and other critical events. The project is designed to also ensure continued electricity to ferries, buses, and critical operations facilities.

Researchers Daniel Villa (6926), Howard Passell (0159), Will Peplinski (6926), Len Malczynski (159), Max Ottesen (6925), and facilities managers Jack Mizner and Gerald Gallegos (both 4853) are using Sandia's science and engineering expertise to reduce site-wide energy consumption. The resulting model, Institutional Transformation (IX), complements eQUEST, a DOE building modeling environment. IX models capital or operational investments across hundreds of buildings, using customizable conservation methods and renewable energy options. Planners can experiment with different approaches across the entire institution and select strategies that save the most energy. (6900, 0100, 4800) EC [SSEF]



ALAN KRUIENZA

characterization and analysis of molten nitrate salts used as heat transfer fluids for concentrated solar power and enhanced oil recovery applications.

Alan Kruienza (8223) patented a novel high-temperature energy storage system with the potential to cut the cost of thermal solar power in half. Working with Concentrating Solar Technologies Dept. 6123 in the EC PMU, Alan has established several industry partnerships providing materials

While the powerful solvents known as ionic liquids (ILs) show great promise for improving the economics of deriving advanced biofuels from lignocellulose, an even more promising candidate is on the horizon — bionic liquids. A team led by Blake Simmons (8610) and Seema Singh (8634), working at DOE's Joint BioEnergy Institute, has developed bionic liquids produced from lignin and hemicellulose, two byproducts of biofuel production. Sugar yields after pretreatment with these bionic liquids were comparable to the yields obtained with the best-performing imidazolium-based ILs, but the costs of the bionic liquids are much lower than those of the imidazolium-based ILs. (8600) EC [SSEF]



BLAKE SIMMONS AND SEEMA SING at DOE's Joint BioEnergy Institute.



ROBERT BARLOW

His work is leading to an improved understanding of the fundamental nature of turbulent combustion, which, in turn, helps provide detailed data sets for developing and evaluating computer models that will eventually be used to design advanced combustion systems for transportation and power generation. (8300) EC [SSEF]

Robert Barlow (8351) won the Alfred C. Egerton Gold Medal at the 35th International Symposium on Combustion. Robert was honored for pioneering contributions to simultaneous laser diagnostics and their application to the understanding of turbulence-chemistry interactions in flames.

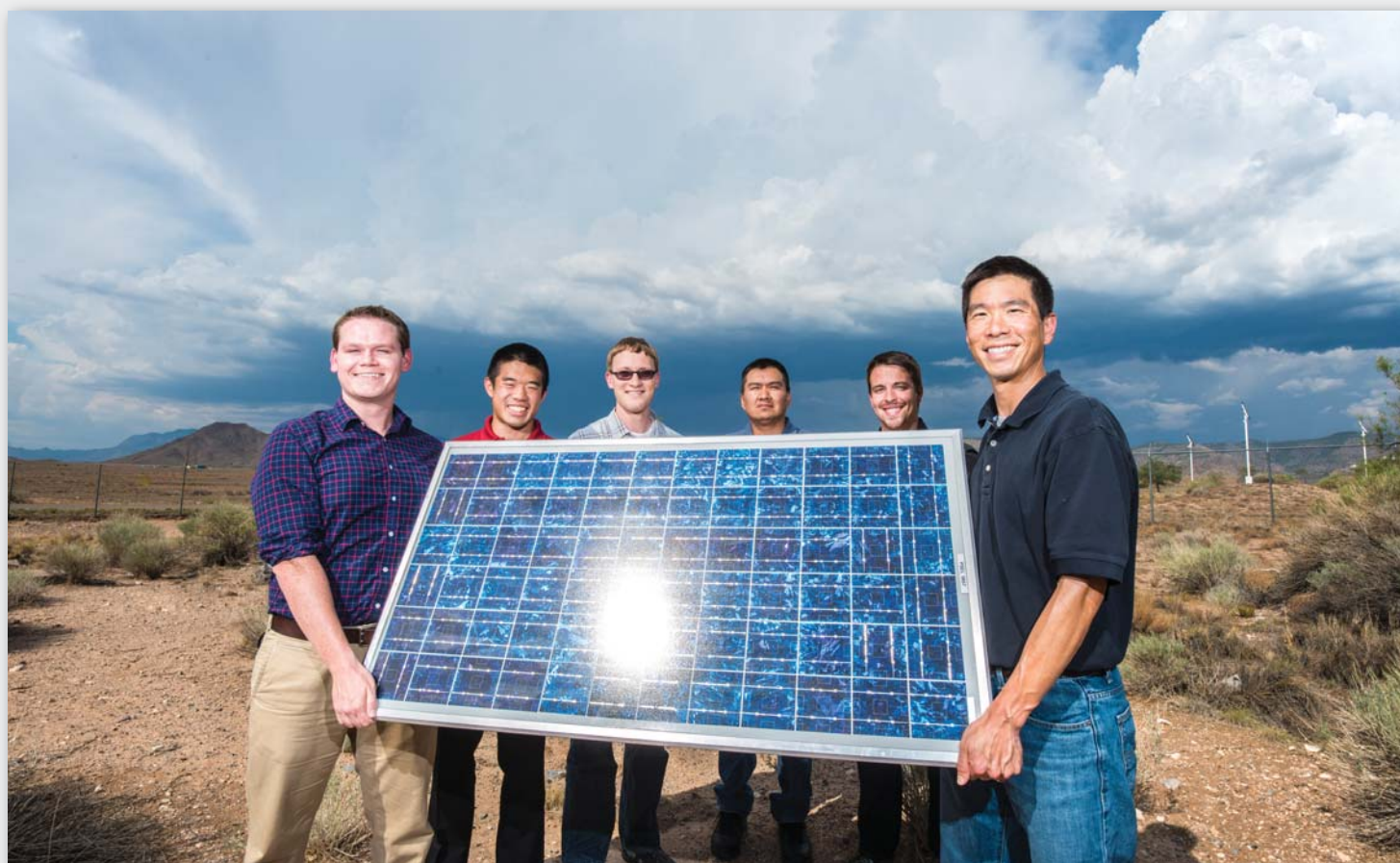


## Energy

**Sandia's Solar Glare Hazard Analysis Tool (SGHAT)**, a 2013 R&D 100 Award winner, has been used by more than 100 airports in nearly 50 countries to safely deploy photovoltaic systems while mitigating associated glare hazards. In FY14 Sandia helped to address glare issues reported by pilots flying over the world's largest concentrating solar power plant (Ivanpah). The use of SGHAT is required by the Federal Aviation Administration and DoD for proposed solar energy installations at all federally obligated airports and DoD aviation operations. (6100) EC [SSEF]

COMPLAINTS OF GLARE from pilots flying over the Ivanpah Solar Electric Generating System (left) were evaluated by Sandia and found to be caused by heliostats in standby mode (right). Sandia worked with NRG and Brightsource Energy to resolve the problem.

(Photo by Randy Montoya)



**Sandia staff made great contributions** to the technical basis for the safe and secure long-term storage and transport of used nuclear fuel (UNF). This work included continued development of a model to predict hydride formation in UNF cladding, understanding if conditions are present to initiate and support stress corrosion cracking in canisters, quantifying the strains UNF rods experience during transport, understanding costs in different large transportation scenarios, analyzing how to best ensure security, and initiating an uncertainty quantification effort to focus further R&D. (6200, 1800, 1400, 1500) EC [SSEF]



SANDIA'S SURROGATE Used Nuclear Fuel Assembly is made up of 264 rods, which typically contain nuclear fuel pellets held together in the rod cladding. Many of these assemblies are being stored in dry storage canisters awaiting transportation to final disposal.

**The Radioisotope Power Systems Launch Safety Project** completed two major milestones in FY15. The first was the Nuclear Risk Assessment (NRA) for the launch of the next nuclear-powered rover to Mars in 2020. The NRA serves as the foundation of the Mars 2020 Environmental Impact Statement that NASA issued on Nov. 6, 2014. The second was the Draft Safety Analysis Report for the Advanced Stirling Radioisotope Generator, which is a new nuclear battery design. (6200, 1500, 5400) EC [SSEF]

**The 3rd Compliance Recertification Application** for the Waste Isolation Pilot Plant (WIPP) was submitted for regulatory approval on March 26, 2014.

The application included numerous updates to important WIPP parameters and processes. New Sandia experimental results allowed for refined representation of WIPP waste shear strength and enhanced understanding of iron corrosion in WIPP conditions. A new staggered analysis approach was developed that allows for transparent and direct determination of regulatory compliance impacts, with enthusiastic reception by DOE and EPA. (Center 6200) EC [SSEF]



SANDIA VERTICAL FLUME facility used to generate experimental data for the shear strength of surrogate WIPP waste.



LANL AND SANDIA ROBOTS at the WIPP site for capability demonstrations.

**While Sandia has served for decades as science adviser to DOE** on matters pertaining to the Waste Isolation Pilot Plant (WIPP), we were called upon this year to engage in out-of-the-ordinary ways to support the recovery of WIPP following two incidents in the WIPP underground that occurred within nine days of each other — one a fire and the other a radiation release. We collaborated with Los Alamos National Laboratory and offered robotics expertise to facilitate the initial re-entry to the WIPP underground (assistance ultimately deemed not to be needed), and we subsequently joined the WIPP Technical Assessment Team, a five-lab consortium chartered by the Secretary of Energy to investigate the causes of the radiation release and to assess the likely extent of condition. (6200, 6500, 2500, 1500) EC [SSEF]



SUSAN ALTMAN

**Susan Altman** led a team of 11 Sandia scientists and engineers working with 19 faculty at the University of Texas at Austin to complete the five-year Center for Frontiers of Subsurface Energy Security (CFSES) Energy Frontier Research Center funded by the DOE Office of Science, studying multi-scale, multi-

physics processes in carbon sequestration. Susan then led the crafting of the successful renewal proposal for four additional years. Seventy-two peer reviewed articles resulted from this work, including a cover article in the *Journal of Physical Chemistry*. (6900)

## Robotics



TWO ADVANCED GROUND Sample Collection Platforms posed in front of an air sample collection platform.

**Sandia developed and delivered two robotic systems in 2014.** The first, the Advanced Ground Sample Collection Platform, is a robotic system that allows operational forces to perform radiation reconnaissance and ground sampling missions following a nuclear detonation. The second, the Multiple Launch Rocket System robotic

demilitarization system, is deployed at the Anniston Army Depot to disassemble grenades from the warhead and remove the fuze assembly from each grenade body. Sandia has developed advanced automation solutions for high-consequence tasks and missions for a variety of customers. (6500) IHNS [NAW]



## HR, communications, finance, & legal



**Department of Energy Secretary Ernest Moniz** saw a need for an event to spotlight the extraordinary work conducted by DOE's system of 17 national laboratories. The result was Lab Day on Capitol Hill, in which Sandia played a key role. The successful event was very well received by congressional attendees and provided a better understanding of the innovations that advance US technical and economic competitiveness. In coordination with DOE, Sandia's social media provided heavy promotional support before, during, and after the event. (7000, 3600, 100, 01) IMS [LF]

**USING 3-D TECHNOLOGY FOR MEDICAL SCIENCE** — Scientist Dave Bushnell presents 3-D models of the H1N1 virus to Rep. Eddie Bernice Johnson, Sen. Lisa Murkowski, and Secretary Ernest Moniz, each wearing 3-D glasses. Bushnell is one of many scientists that uses SLAC Lab's X-ray light source user facilities to determine the 3-D structures of proteins, atom by atom — a technique called protein crystallography. Determining the structures of proteins lets researchers design optimal drugs, which are molecules that have to fit into particular locations on each protein.

**Division 8000 initiated a focus on boosting managers' skills in talent development.** As a result, several strategic initiatives were created and executed, including a leadership development workshop focused on Herzberg's motivation theory, a succession planning pilot, difficult conversations training, and a comprehensive talent development model. The model has four focus areas: coaching and feedback, mentoring, career development, and succession development. The model's foundation is based on ongoing one-to-one dialogues with employees. The model was introduced at the December management offsite meeting, and will be followed by continued education in 2015. (8000) IMS [LF]

**Executive leaders facilitated six formal mentoring sessions** to share knowledge and discuss leadership competencies through the Executive Roundtable Mentoring program. One hundred level-one managers participated, addressing topics such as enhancing customer relationships, developing political savvy, and leading change. The third-year program was launched for FY15 with 50 senior managers, with each participant partnered with a mentor. (3000) IMS [LF]

**Sandia continues to make progress in building a diverse and inclusive environment.** As part of that ongoing initiative, Sandia leadership has championed the Effective Leadership of Inclusive Teams (ELOIT) awareness sessions. ELOIT is designed to create an environment where all individuals can honestly explore their real questions, challenges, and aspirations about diversity issues in their organizations and lives. To date, almost half of Sandia's management has participated in one of these sessions. Sandia will continue to offer ELOIT sessions with the intent to expand across the Laboratories. (3000) IMS [LF]

**In partnership with Div. 9000,** Human Resources automated the New Hire Buddy Program, which resulted in the hiring manager participation rate rising from 49 percent to 86 percent in FY14 and resulted in more than 900 new hires being assigned mentorship buddies in FY14. (3000, 9000) IMS [LF]

**Human Resources completed an evaluation of the Sandia Required Training** and reduced those training requirements, yielding more than \$300,000 of potential savings over a 12-month period from implementation. (3000) IMS [LF]

**Sandia assumed leadership of the Contractor Financial Management Alliance (CFMA)** effort in the DOE complex, with Sandians serving in chair and executive director roles. The Sandia-managed CFMA website and clearinghouse are cross-complex financial information resources. Over the past several months, the website has received some 2,700 webpage views and the clearinghouse received 18 requests for information and 140 responses. CFMA created a working group to explore opportunities for better pricing. Additionally, CFMA initiated a benchmarking effort to establish baselines, define best practices, and identify improvement opportunities. (10500) IMS [LF]

**To amplify our national security impact,** Sandia successfully leverages social media as an essential component of the Labs' external communications practices. In FY14, Sandia became the first US national lab verified on Twitter. Sandia's social media was recognized with an Academy of Interactive & Visual Arts award, selected from among more than 6,000 companies and agencies of all sizes. Sandia social media was highlighted multiple times by analytics services, media, and social networks as among the most engaged government content. During FY14, Sandia's presences saw a total average 38 percent growth in audience. (3600) IMS [LF]

### Follow us



**HBE launched Energy Hubs to boost productivity and energy.** The Bldg. 810 café opened, a Guest Chef series was launched, and nutrition tracking barcodes were introduced to increase onsite options and healthy food choices. Tracks were added to the Health Action Plan program to address Sandia-specific health risks. A pension calculator was introduced to estimate benefits, "line of sight" was added to the ePMF to better align objectives, and a consumerism campaign helped keep premiums low and assist employees with getting the most out of their benefits. (3300) IMS [LF]



**SANDIA EXERCISE PHYSIOLOGIST Jon Pier (3334)** says research supports the idea that short breaks throughout the day can aid in recovering posture, restoring energy, improving focus, and managing stress.



## Governance, leadership, & management

**Establishment of the Counterfeit Detection Center (CDC)** at Sandia optimizes R&D capabilities to support the national security community. Multiple Sandia organizations involved in programs, research, finance, facilities, and security developed a strategy to repurpose an existing building. Sandia partnered with a consortium of government sponsors to optimize the location of R&D capabilities residing in various “shoebox” locations throughout Tech Area 1. Joint customer investments in infrastructure resulted in co-location of six capabilities into one physical location. The success was realized through community vision, commitment, and collaboration. (4200, 4800, 5600, 5900, 10500) [Cyber]

THROUGH JOINT CUSTOMER investment in infrastructure, six capabilities were co-located in one physical location in Sandia Tech Area 1.



**Sandia is automating the revenue projection process for all of its programs.** The Long Range Planning Automation Initiative will work to improve Sandia’s ability to ensure the appropriate workforce mix to carry out its missions. Currently two of the four Program Management Units have used an automated projection tool, which is now being developed for Labs-wide use. (10600) IMS [LF]

**The development of a project management framework that enables** a graded approach for implementing project management was completed. Several projects in their planning or early execution stages have been identified for pilot testing using the framework over the next year. A key attribute of the framework includes a review to determine the appropriate project management “level-of-rigor.” This effort was discussed with the Sandia Corporation Board of Directors’ Governance subcommittee. (10600) IMS [LF]

**After receiving notice in March 2014** that the prime contract between Lockheed Martin and DOE/NNSA would not be put out for competitive bid but would be extended, a team consisting of members from Organization 3, Divisions 3000, 10000, and 11000 and Lockheed Martin was formed. The team worked with a short deadline preparing information and negotiating complex and important issues between Lockheed Martin, DOE/NNSA, and Sandia. On April 30, 2014, a contract extension was signed extending the contract to April 30, 2016, with an optional one-year extension. (11000) IMS [LF]



JULIE CORDERO

The Facilities Management and Operations Center’s Julie Cordero (4879) was named Sandia’s official nominee for the 2014 HENAAC Community Service Award. As Sandia’s first female fire marshal, Julie frequently forges her own path and serves as an inspiration to others. Whether as a coach, mentor, public speaker, or friend, Julie is

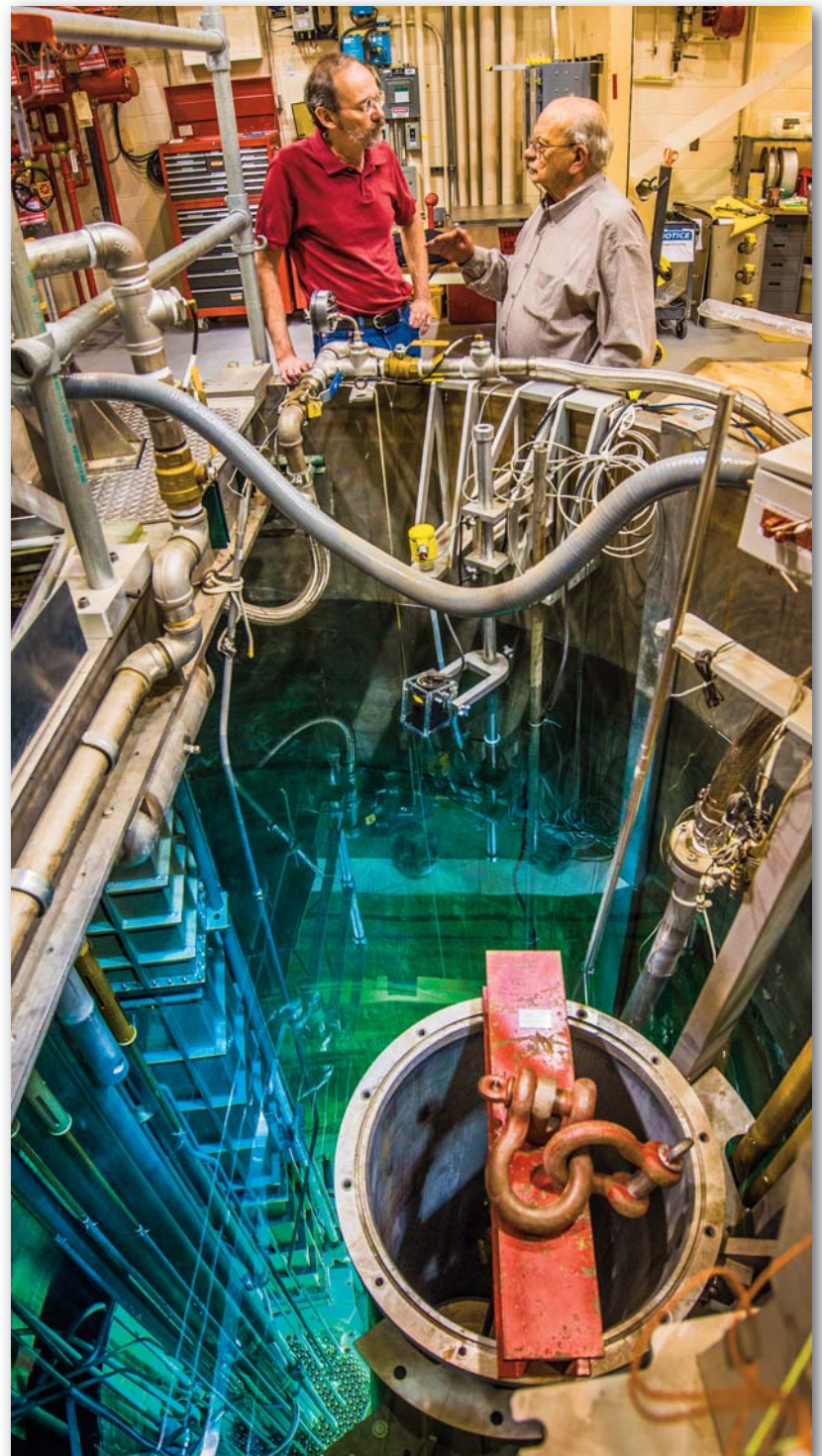
actively involved in the community. Her current support includes work with the New Mexico Professional Chapter of the Society of Hispanic Professional Engineers (SHPE), Petroglyph Elementary Science Fair, and Sandia’s Hispanic Leadership Outreach Committee (including Manos, HENAAC College Bowl, and the Hispanic Heritage Month Committee).

## Tech Transfer

**Eden Radioisotopes, an Albuquerque startup company,** has entered into an exclusive licensing agreement with Sandia to use Sandia technology to solve the world’s medical radioisotope shortage crisis. Mo-99 is a key isotope whose daughter product, Tc-99, is used almost exclusively in nuclear medicine diagnostic imaging. With a half-life of 66 hours, Mo-99 must be continuously made to meet the world demand. Sandia holds a patent pending on a new nuclear reactor concept that allows for Mo-99 to be made economically, safely, and reliably. (1300) IHNS [RGND]

DICK COATS, right, Eden Radioisotopes’s chief technology officer and a retired Sandian, talks science with nuclear engineer John Ford (1381) at the Annular Core Research Reactor, where they helped develop a molybdenum-99 reactor concept in the 1990s. Eden recently licensed the technology with the goal of producing a US supply of moly 99 for use in nuclear medicine. (Photo by Randy Montoya)

**Sandia materials researchers Roger Rasberry and Garth Rohr** helped Apache Fire Industries, a New Mexico small business, resolve issues related to developing the Fire Ant, a device designed to help save firefighters’ lives by illuminating a path out of smoke-filled environments. The Fire Ant is a hose-coupler with LEDs that activate upon impact as a fire hose is deployed. Colored LEDs assist firefighters understand their location in the hazardous environment. Fire Ant is being tested by the Chicago Fire Department. (1800) [LDI]







SEAN KEARNEY studies jet flames with laser diagnostics to make temperature and soot measurements of the heat released from a fire onto a weapon system.  
(Photo by Randy Montoya)